W. G. Hughson

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EDITORIAL

The Conference this year proved a most enjoyable and useful function, attended by a record number of chemists. Judging by the comments received by the Conference Committee, its efforts seem to have been crowned with success, to which our Australian visitors made a notable contribution. The number of papers provided was sufficient for eight sessions; two series of papers were read simultaneously to large and appreciative audiences. The exhibitors of apparatus and books report good business.

All these factors seem to add up to a very satisfactory Conference, but we have our doubts. Prof. Worley gave expression to some of these in the General Meeting when he referred to the poor delivery of many of the speakers in the various scientific sessions. The material was often good, but heavily discounted by the audience because of the strain involved in listening. This criticism applies to speakers from all branches of chemistry—even University lecturers. We ourselves were rudely shocked to find our voice unsuitable for broadcasting, and it seems that if chemistry is to get the public recognition we all feel it should, many of us must have some training in public address to worthily represent it. A minor feature was that few speakers seemed to have prepared themselves so that their papers were delivered in the time available. The result was that many transgressed badly on the time which should have been available for discussion; others left out sections of their prepared notes, which at least upset the balance of their efforts.

The Conference Committee indicated to Chairmen of Symposia that papers should indicate the speakers' own work rather than reviewing the overseas literature. In this the Committee must feel a little disappointed. Too many papers had little reference to work done in this country, and some could have been delivered by people who had done no experimental work in the field at all. While many speakers must refer to overseas work in discussing their own, we feel that the audience is more concerned with the latter than the former, which is less likely to help workers in the various fields, including the speakers themselves. This would apply even (and perhaps more so) if the work were incomplete.

Our ideal paper must therefore meet three criteria: it must be well delivered, fit neatly into the time available, and refer to the speaker's own work. It may be that one or two speakers should be asked to deliver reviews of about an hour's duration on selected topics at future conferences, or that reviews are less suited to reading than to publication in a journal such as this one.

PROFESSOR L. H. BRIGGS

The first award of the Imperial Chemical Industries Prize has been made to Professor L. H. Briggs of Auckland University College. The final adjudication was left to Sir Ian Heilbron, who cabled his decision with very high praise for Dr. Briggs' published work. The prize, which is valued at 25 guineas, is awarded on published work in the previous five years.

Dr. Briggs is an Auckland graduate, and after post-graduate work at Auckland and Massey, he proceeded to Oxford where he studied under Sir Robert Robinson, and took his Doctorate. In 1933 he took up the position of lecturer in Organic Chemistry at Auckland, where he has been ever since. In 1941 he obtained the degree of D.Sc. in the University of New Zealand, and in 1947 was appointed Associate Professor. He has taken a keen interest in the affairs of the Institute and was for several years on the Auckland Branch Committee, being Chairman and Delegate in 1942-3. He is at present serving on the Membership Committee. Professor Briggs is a first grade Rugby referee and is often seen in action on Eden Park. He is also an elder in the Presbyterian Church and a profound student of detective fiction. He recently returned from a very strenuous tour abroad. During the Conference, he was unfortunately taken seriously ill, and has since been in hospital, but is now recovering.

MR. H. H. EDWARDS

At the last meeting of the Council, Mr H. H. Edwards was elected to the Fellowship on the advice of specially appointed assessors. Born in England, he came to New Zealand in 1921, and until 1943, was chemist to the Auckland Farmers' Freezing Co. In that year he founded, in conjunction with Mr Morcom Green, the firm now known as Morcom Green and Edwards at Onehunga, and has been in charge of the technical side of the firm's operations. During the war notable work was done in the manufacture of naphthenates and heavy metal soaps for the preservation of textiles and for petrol thickeners for military use. They are now manufacturing paint driers as their main product. Mr Edwards has been an Associate since 1932.

DR T. S. MA

Chemists in New Zealand, particularly those directly concerned with fundamental research will be interested in the arrival at the Chemistry Dept., University of Otago, of Dr T. S. Ma. Dr Ma has been appointed as lecturer in micro-chemical analysis there, but although he is stationed at Otago, the analytical services will be available to the other University colleges and research groups in the special schools. Although the primary purpose of the appointment is to provide for the elementary micro-analysis of organic compounds, Dr. Ma will set up a complete micro-chemical laboratory, dealing with organic and inorganic analysis, micro-techniques in chemistry, the use of polarography, spectroscopy, etc.

Dr Ma graduated Ph.D. from Chicago University, after which he held a position for several years in charge of the micro-chemical laboratory at that university. Following that, in 1946, he returned to China, taking up a post as Professor of Chemistry at the National University at Peiping. When the advancing Communists took over Peiping, Dr Ma became visiting Professor at Lingnan University, Canton, and he left there in July to come to New Zealand.

GOVERNMENT RESEARCH AS AN AID TO SECONDARY INDUSTRY

Public Address delivered at the Annual Conference, August, 1949,

By DR. I. W. WARK, C.S.I.R.O., MELBOURNE

The earliest scientific research, upon which industry is ultimately based, and upon which present-day research is also based, was done by men who sought only to satisfy their own curiosity. Mostly they were ignored by society or regarded as eccentrics, but some, like Copernicus and Galileo, were actively persecuted as enemies of existing social systems. Never were the pioneers of science supported by governments. It is true that some, like Leonardo da Vinci, enjoyed the patronage of powerful men, which patronage might be regarded as the precursor of governmental support for scientific research. The Royal Society of London, founded about 1660, was the first group of scientists to receive official recognition in Great Britain—a sign of increasing interest in scientific research. The appointment of John Flamsteed as "astronomer observator" in 1667 by Charles II was perhaps the first official appointment of a scientist. Incidentally his stormy life suggests that the position was no sinecure.

Under the handicap of the indifference of the ruling classes science developed but slowly until the industrial revolution of the 19th century. Some of the few who had studied and developed science for its own sake then found themselves able to apply their knowledge in improving industrial processes and evolving new ones. Others who, under older regimes, would not have been able to indulge an interest in science, studied in the universities and went into industry. Progressive companies sought their services: unprogressive companies passed out of business. Already science was sounding the death-knell of industrial inefficiency.

Soon governments began to realise that countries which were to lead the world in industrialisation must apply scientific facts and methods in technical manufacturing processes. Often the rulers of the people were the leaders of industry as well; they put their ideas into practice privately, without setting up governmental laboratories to assist industry. Science advanced rapidly, but the first World War found both Britain and U.S.A. unprepared to make the full use of science upon which speedy victory might have been based. To both countries came a realisation that industry must turn more to science if it were to flourish, but in the years which followed they adopted different methods to achieve this objective. These will be considered later.

Nowadays it is agreed in all progressive countries that governmental research should supplement what is done by industry and the universities. There is by no means full agreement as to how far governments should go. I have my own views on this matter, which will become apparent as I proceed, but I must emphasise that they are purely personal. They are not necessarily shared by my colleagues in the Australian C.S.I.R.O.

It may be helpful if, at this stage, I state what I propose to discuss in this address. Firstly, I shall develop the theme that industry does benefit from research. Secondly, I shall deal with the question of what industry does to provide for its own research needs. Thirdly, I shall come to the very controversial topic of how far governments should go in sponsoring research to help industry, which necessarily varies from country to country. Finally, I shall attempt to support my viewpoint by reference to some of the work being done in my own Division of the C.S.I.R.O.

Does industry benefit from Research? There are always some people who claim that science causes more disruption than it is worth, and that the community in general, and industry in particular, would be better off if scientists were discouraged or even forcibly prevented from doing further research.

If you were the owner of a rubber plantation in New Guinea you might be inclined to agree with them. Chemists and chemical engineers would then be threatening your business. Already they have made synthetics which are as good as natural rubber for most purposes, are better for others, and only in a few products, such as large tyres, are inferior. They produce their synthetics at competitive prices, and in the laboratory they are trying to make tailor-made synthetic rubbers for every purpose.

But before we agree to banish him, let us consider the case for the synthetic chemist. When Japan embarked on what she regarded as a safe war, she speedily took possession of ninety per cent. of the rubber plantations of the world. Since you cannot fight a modern war without rubber, it seemed to her rulers, no doubt, that all they had to do was hang on to the plantations and wait for the Allies to wear out the tyres they possessed and the few replacements per vehicle that could be made from the stockpile. They made a fatal miscalculation, in that they ignored the capacity of American scientists, industrialists and technologists to achieve the near-miracle of producing synthetic rubber to the extent of one million tons per annum in an incredibly short time and, what is more important, exactly to schedule. The stockpile of natural rubber never disappeared completely, and with the supplies obtained from Ceylon there was always sufficient to provide a small but essential amount for use in the production of large sized tyres. Thus the synthetic chemist, though he may now threaten your plantation, saved your country from invasion, and even played a decisive part in helping the Allies to restore your plantation to you. If you are a wise planter, you will have joined with other plantation owners, and will be supporting the excellent research work now being done with a view to improving the properties of natural rubber and finding new uses for it. Because of this you will probably weather the storm. Meantime the research men in both camps are giving to the world better products than were available in the pre-war era.

All of us have a better standard of living than corresponding people of any preceding generation, at least with respect to material things. It would be still higher but for the loss of production in consumer goods during the war. Please do not delude yourselves that the trades union secretary, the politician or the economist gave you the advantages of electric light, radio, nylons and the automobile. They were made possible by the alliance of science with industry, as was also your shorter working week, your purer food and improved sanitation. There are now more people in the world to be fed and clothed than ever before; but for the advances that have come from research, the standard of living would be falling steeply, rather than rising. So keen an observer as H. G. Wells has described the researcher as the key man of the New World.

You are thinking, perhaps, that these generalisations are all very well, but as the owner of a business of moderate size, you would like some evidence that research would pay **you**. I am afraid that I cannot give you an assurance on this point. True research involves some element of gamble for the backer, and adventure for the researcher. If supported for a sufficient period—which may be some years—research will pay rich dividends in a sufficient number of cases to make it highly profitable **on the average.** On the other hand, the skilled technologist will always earn his keep; his function is to apply well established scientific principles to the processes with which he is concerned; to keep abreast of scientific and technical developments in his field, and to see that, where it would be economic to do so, they are applied. Thus the small business man can always afford the technologist, the large business the research man. Often, of course, the technologist undertakes some research and the research man turns technologist for a time.

The catering firm of Lyons of London began a research department in a small way in 1919, with a total staff of four. You may suspect there would be little scope for scientific research to increase the dividends of a catering firm. If so, you are wrong. Within three years the success of the department had led to an expansion of staff to well over twenty, and in eight years to 72!

Nearer to New Zealand, the firm of Taubmans, Sydney, manufacturers of paints and related products, had a research staff of two qualified men in 1939. By 1946 there were 11, and by 1949, 22. Meantime the total technical staff, including the research staff, had grown from 12 to 58.

It is well realised in America that research is essential to survival. The Eastman-Kodak Company's budget for experimental purposes grew from almost nothing in 1912 to $5,000,000 per annum in 1941. For that year, research took nearly 25% of profits. The American Administration's key man of science, Professor Karl Compton, has urged that all companies in his country should spend 2 per cent. of their gross earnings on research, a figure well below that provided by the leading chemical firms.

Coming to my second question—**how far does industry help itself**—I must draw a sharp distinction between industries that have been founded during the last century and those which have their roots in antiquity. The new industries owe their inception to laboratory work; they have always leaned heavily on research and will continue to do so. As an example, one might cite the Plastics Industry, wherein each group conducts a huge amount of research work, and where fierce competition is an ever-present spur to progress. While it is not generally realised, the traditional industries also owe their existence to research, but of a far less formal type. The tanner of today has inherited the contributions to his art made by countless experimentalists of by-gone ages, men who made their experiments without the principles of modern science to guide them, but who, nevertheless, discovered in the aggregate a vast amount of information about leather and tanning. The tanner and the fellmonger, the foundryman and the brewer, are therefore not so likely to be aware of the need for research as the manufacturer of plastics or radios; nevertheless, he has just as much to gain from the effective use of science.

It would be unwise to generalise concerning the amount of research done in different countries in different industries, or in different companies within those industries. Nevertheless, there are some broad trends to which I shall refer, starting with U.S.A. and working gradually round the world to the western side of the Pacific.

The big companies of U.S.A. spend huge sums on research. They have elaborate central laboratories where the more basic research is conducted, and small research laboratories at each plant. They let research contracts to the universities. They are in the market for every new type of instrument or equipment and their pilot plant is superlative. Many of them, for obvious reasons, are not prepared to sponsor research for which there is no apparent application in their field of business. As the universities have reduced their own fundamental research programmes—owing to decreased purchasing power of the dollar—there is a danger that the country may be forced to rely, even more than in the past, on the basic research done in other countries. America has never led the field in pure research, though she has lapped it several times in technological research, facts well illustrated in the evolution of the atomic bomb.

This danger is recognised by some of the leaders in industry and science and they are wondering why a country with such resources, and which spends so liberally on research, has not produced more Nobel Prize winners. My own view is that there has been no general realisation that the methods adopted to promote efficiency in production—which have been extremely successful—are unsuitable when applied to research. Bustling and first-rate research are incompatible: so are time-clocks and research: even more so are the demand for quick results and research. Until America realises that the first-rate researcher has the temperament of an artist, its major successes will continue to lie in the application of the ideas of outside scientists. Under the present system the research man turns to the type of project that will be certain to give him a minor success, rather than to undertake the adventurous research which may give him a major one. In a world forever striving for security, surely it is the privilege of science to keep alive the spirit of adventure.

For the company not big enough to set up its own research laboratory, Research Foundations have been established in several States. Some, such as the Mellon Institute of Pittsburgh, and the Armour in Chicago, are world-famed. American industry is behind these Foundations and the universities like to be associated with them. In general they are non-profitmaking and are heavily endowed. A company can establish a fellowship for the investigation of an approved problem. The company owns the results, and any patents arising from them, though the Foundations like to publish the results by agreement with the sponsor. The minimum contract is for one year, which emphasises the fact that American companies regard it as their own job to look after their day-to-day problems—a point I would ask you to note especially.

There is an insidious growth of industrially sponsored work within the Universities and leading Institutes of Technology. The short-term beneficiaries—the institutions themselves and their staffs—claim that there is no harm in this, but there are some who see danger ahead and who steadfastly refuse to climb aboard the bandwaggon. Both in England and America are many professors whose consulting fees far exceed their salaries. They make a good case for themselves. Are they not keeping in touch with industry and choosing projects that will assist it? Are they not establishing contacts that ensure good positions for their graduates? The Universities, impoverished by inflation, their staffs left behind in the struggle against the cost of living, and the companies providing a starvation wage for the Ph.D. students doing valuable work for them, are both satisfied. Yet year after year the Universities slip further under the thumb of the companies; year after year their research becomes less disinterested; year after year there is more pressure on the will-power of those who resist. A reasonable amount of this sort of thing is desirable, probably necessary, but in my opinion it has gone too far in many institutions both in U.S.A. and England. We must strongly oppose a drift from the free research of the endowed University to the controlled research of the dependent University.

America is very much pre-occupied with defence. It plans to set up a supreme body which will control the allocation of additional research funds, and there has been much discussion as to the form of control that should be exercised by the people over the spending of this money, with a three-cornered battle between scientists, civilians and the Services in the background. Though the Government has its own civil and defence laboratories, much of the work proposed—whether defence or civil—will be done by letting contracts to Universities and to Indusry. There is again a danger that the Universities may lose some of their independence, particularly if they accept contracts for secret research, but the tendency is to accept the position that if this work is not done by those most able to do it, **wherever they may be,** the nation may lose its independence. On the whole it is deemed expedient, therefore, to sacrifice minor freedoms to preserve major freedoms. There are many, on the other hand, who contend that once a nation starts on this course it is doomed anyway.

Across the Atlantic, in Great Britain the Research Association replaces the Research Foundation. This has both advantages and disadvantages, though the worst of the latter might have been avoided, and have indeed been avoided in the more enlightened Research Associations. In the Research Association the firms comprising an industry join together to set up a research organization to serve them all; when sufficient agree the Government insists on all firms in the industry contributing, and itself subsidises the Association through the D.S.I.R. There are now nearly forty Research Associations in Great Britain, covering such widely differing fields as non-ferrous metals, leather, laundering, coal, wool, iron and steel, and cotton.

Industry likes these Research Associations. They do what it wishes, for the governing board of each is elected mainly from the industry it serves. Their policies naturally vary widely but, in my opinion, some put far too much effort into solving the specific problems of individual companies, and are left with insufficient resources to tackle the major common problems, or to do the adventurous type of work that will lead to revolutionary advances. It is just these that Industry needs in England—not minor improvements that will reduce costs by a fraction of one per cent.

May I recall the fact that the leading Research Foundations of America will not undertake work on the minor problems of industry. They expect a company to employ its own technical staff, and to solve its "housekeeping" problems on the spot. In my opinion the most useful service a research director can do for a small company is to persuade it to employ its own technical staff. For one cannot have science in industry without the scientist in industry, nor sound technology without the technologist. It is not easy to persuade the non-technical manager that this is a sound policy, but it is worth the effort. I fear it is not the policy of some Research Associations to do so, for they like to be able to point to numbers of instances where they have given help and advice to the units of the industry they serve. This may be sound in the first stages of development, but should surely be unnecessary when an Association has come of age.

In England industries are concentrated geographically — cotton around Manchester, wool around Leeds, pottery around Stafford, and so forth. Naturally the Associations have placed their laboratories close to the industries they serve, though some, like Iron and Steel, have branches in several cities. I have no quarrel with this, but I do think it disastrous to put a research laboratory of narrow outlook in splendid isolation on the outskirts of a city or in the country. To remain virile, an Association whose men are thinking primarily about one material, needs the broadening atmosphere created by men of many interests. Thus I consider that the British Research Associations would be doing better work had they been placed in groups, or had they been erected alongside the Universities. The latter alternative would have been good for the Universities also. If I have learned anything from years of close association with both pure and applied research, it is that applied research flourishes and continues to flourish only when it is done in proximity to related fundamental work. Mine is a counsel of perfection, I realise, because most Universities are in the middle of built-up areas and it is difficult to obtain sites abutting on them. However, I hope this country will not make the mistake of establishing small laboratories on isolated sites. It was with gratification that I heard, after preparing this address, that a group of six research associations has recently acquired a common site at Leatherhead, near London.

Please do not think I have not a profound admiration for the Research Associations of Great Britain. They have done, and will continue to do, most valuable research; their prestige is rising fast. I think I can see mistakes in some of their policies, and would not like to see them repeated elsewhere.

Many companies in Great Britain have fine research laboratories; America has no monopoly in this direction. These same companies often support the Research Associations as well, just as the U.S. companies with laboratories of their own are among the firmest supporters of the Research Foundations.

The contrast between America and England is not quite so sharp as I have made it. There are some research associations in America, and there is at least one Research Institute—the Fulmer—in Great Britain. There are also strong firms of research consultants in both countries, though this phase of research activity is more strongly developed in U.S.A., where the leading consultants maintain impressive research laboratories.

I have drawn attention to the fact that some Americans are wondering why, having excelled in applied research, they have lagged in pure research. Likewise, Sir Henry Tizard and others in Great Britain are wondering why a nation which has excelled in fundamental research has lagged in its application to industry. It was the British more than any other race, who made the basic discoveries that made radar and the atomic bomb such decisive weapons in the Second World War. Even though Sir Henry pleads for much greater emphasis on bold and highly skilled engineering, it would be lunacy to allow this to take precedence over fundamental work: they are equally important. Somewhere between the American and British positions lies the ideal, where basic discoveries are made, and where they are also **speedily** applied in industry.

In Holland such companies as Philips and Shell have enormous laboratories. There are also Research Associations — usually working in association with the Universities — which come under the general jurisdiction of T.N.O., the Dutch counterpart of the British D.S.I.R. For its size Holland has excelled in research, as it has in industry; the connection is obvious. I do not wish to convey the impression that Holland has found the ideal; I don't know enough of the research laboratories of that country to generalise, but I did see enough to impress me most favourably.

Proceeding eastward, we pass through a battered Germany, where the British are striving to restore scientific research and where companies such as I.G. Farbenindustrie are again actively working in restricted and controlled fields in well-equipped and very large laboratories. What is the position behind the Iron Curtain? It is impossible to ascertain how much research is done in the factories and how much in research institutions, but we do know there are plenty of the latter. Everything is said to be planned: research is directed entirely towards practical objectives. Yet the journals indicate that much fundamental work is being done. This could mean either that the planners take a very long view, or that the spirit of curiosity has led scientific workers into interesting side tracks away from the main trail.

May I make it clear that, except in passing, I am not speaking of what has become styled as "economic research." I am concerned with research, the deductions from which can be tested in the laboratory. It is a pity this same word "research" is used by the historian, the economist and the sociologist. Much though I admire some of their work, it is well to realise that their deductions lack the decisiveness of science and are not usually susceptible to proof except over very long periods of time. In making this statement I do not lose sight of the fact that scienitfic theories are constantly changing, whereas good experimental work remains forever inviolate.

I have tried to convey to you that in the aggregate the industries fo America, Great Britain and Europe spend vast sums on research. To these must be added the sums spent within the Universities, and in privately-endowed institutions. Yet there remains a gap. Even in the U.S.A. and Canada, the least socialised countries of all, Government Departments are giving much aid to industry and planning to give more. The U.S. Bureau of Mines operates Research Laboratories in several localities where it brings scientific research to bear on problems of national importance. Thus it is studying methods of making liquid fuels and chemicals from coal; it is investigating the metallurgy and chemistry of titanium and zirconium and their compounds; it is obtaining basic thermodynamical data of value to the metallurgical industry in a laboratory that no company could afford to operate for its own exclusive use. During the war it tried many processes for production of aluminium from its own ores, which are of lower grade than the imported ores used exclusively by commercial companies; this was necessary in case imports were cut off by submarine action.

The Bureau of Standards, a huge organisation, renders service to industry in countless ways, not least important being the maintenance of standards, without which industry would come to a standstill. The Bureau of Agriculture has established large research stations in North, South, East and West, where long-term research is directed towards finding new uses for agricultural products and farm wastes; chemical engineering studies predominate in these laboratories, which are not concerned with the raising of crops but with their utilisation.

Canada has its National Research Council, which maintains laboratories to supplement the research done in Industry and the Universities. India and South Africa are also rapidly expanding governmental work with similar aims. And in Australia the past ten years had seen a spectacular increase in the amount of money provided by the Commonwealth Government for research to assist secondary industry. Prior to that most of the work of the C.S.I.R. was for primary industry.

Within the British Commonwealth the tendency has been for federal Governments to set up laboratories following the pattern of those established in Great Britain, but fortunately some have allowed greater freedom than is enjoyed by the British D.S.I.R. Two methods of organisation are possible, and no country has confined itself exclusively to either. You can set up laboratories on an industry basis, or on a scientific subject basis, or you can do both. Though England has its numerous Research Associations, affiliated with its D.S.I.R., it also has its National Physical Laboratory and its Chemical Research Laboratory. Australia's C.S.I.R.O., with its National Standards Laboratory and its Chemical Division, and its embryonic Section of Metallurgy, has its laboratories devoted to specific industries—Forest Products, Buildings, Flax, Fuels and so forth. It also supports the newly-formed Australian Leather Manufacturers' Research Association.

Countries with small populations will not find the systems evolved in older and more highly industrialised countries suitable for adoption without modification. Australia and New Zealand could not possibly set up Research Associations for all the industries already served by Associations in England. Thus, for many years to come, the subject laboratories, exemplified by our Division of Industrial Chemistry, must shoulder wider responsibilities than their counterparts in England. Under these conditions there is an obvious danger of them spreading their efforts to the stage where they will give little assistance to any industry. Our policy has been to guard against this, and in doing so we have been forced, with great reluctance, to ask the rubber industry, among others, not to press us to undertake work on its problems until other more needy industries have been served.

Your country, and mine — for our problems are similar — will use limited resources better if we have a clear understanding of the special difficulties of small countries in these matters. May I spend a few minutes in considering them?

In the first place, we must graciously admit that for many years to come we shall have to accept more than we give. Many of our companies have affiliations with overseas companies or groups. These overseas groups usually maintain effective research organisations and the results are made available to their associates in Australia and New Zealand. I see nothing intrinsically wrong in this, provided firstly, that the price paid for this "know-how" is not unfair; secondly, that the group as a whole entrusts a proportionate share of its research programme to Australia and New Zealand; thirdly, that the group does not obtain an international monopoly, such as existed, for example, in the aluminium industry some years ago. Monopoly will presumably lead to a slackening in research effort; at any rate, aluminium is still produced by a method that is exceedingly wasteful of electrical energy.

Our countries have unique raw materials in which no outside country or company can be expected to display much interest. If we are to utilise them for our own good, or sell them for profit, we shall have to study them, experiment with them, and create a market for products derived from them. Here we have an opportunity to make our contribution to the welfare of the world; here we can prove our research ability and so save ourselves from the exploitation that characterises the trade between highly industrialised and less industrialised peoples. The best protection any nation can have is ability to make what it wants, and this implies ability in research.

Our universities are not developed to the same extent as those of Europe and America. They must be built up so that they can do more research and train more men in research methods. They are more dependent on Governmental aid than some of the centres of learning of England and America. It is to be hoped that in supporting them, our Governments will be as far-sighted as that of Great Britain which, in making its grants to the Universities, does not curtail liberties.

Our graduates go overseas for research experience; in Australia any really first-class graduate can now obtain the necessary finance comparatively easily. Those with an interest in fundamental work tend to remain overseas and the flow in the reverse direction does not yet balance this very serious loss. We must strengthen our laboratories so that we attract more than we lose. New Zealand must strive to provide such facilities that the next Rutherford she produces will stay at home.

Young countries, short of manpower and beset with problems, can very easily make the mistake of demanding immediate practical results from all research work. The best applied research is done in close association with related fundamental research, and it frequently happens that no further progress can be made with an ad hoc investigation until some new scientific discovery is made. Thus the Government should be prepared to let its research men attack investigations having a practical objective on a sufficiently fundamental plane. It is as well to remember that the more fundamental a research project is, the more industries will it eventually serve. Thus research on the properties of surfaces can assist almost any industry; spectroscopy is the servant of all. From this point of view the essential difference between pure and applied research is that with pure research the profits come later, but are often bigger. The decision as to how much pure research can be afforded is not easy, but every country can afford some, and usually more than it is doing.

It is futile to set up laboratories without adequate subsidiary services such as workshops and libraries. It is still more futile to imagine that the efficiency principles that are successful in production are equally successful in research. Naturally, the people who put up the money for governmental research, want it to be spent wisely and they expect their auditors to see that it is. A problem arises here. The auditor must assure himself that each employee works the number of hours decreed, that stores records are in order ,and so forth. The type of inspection needed is comparatively simple in a production department in industry, or in an ordinary government department, where each day is rather similar to the preceding one. But it is difficult when the auditor enters a research laboratory. An experiment once started may not finish until the next morning, and even with all the foresight of which a human being is capable, this experiment may take such a turn that new equipment is needed after the stores clerk has left. Furthermore, no two people are doing the same thing, and no man does the same this week as last. The human aspect must be recognised here. What keeps men working? Generally it is considered that close supervision is needed where the profit motive is absent. The research man has an inner spur that makes supervision unnecessary; he has a compelling interest in his job. If he loses it — and this does happen occasionally — he should be transferred to another project, or he should leave. There should be but one rule for research officers, namely, that a man who has insufficient self-discipline to adapt himself to a regulation-free environment must leave it.

I have referred to the fact that, even with the maximum foresight of which a human being is capable, a research man cannot foresee everything he will want. There will be need to buy things quickly, to have them made quickly. Unless the normal rules are sometimes set aside — such as calling for tenders — highly paid officers will waste their time and lose their keenness while waiting for equipment. Thus far more money will be lost than if the system is administered with discretion. It is the efficiency of the organisation as a whole that is important, not that of a stores system or a workshop. The first-rate auditor realises this, but the actual auditing is usually done by men who are expected to conform to rules themselves. It is difficult to obtain a satisfactory compromise, but some countries have been far more successful than others.

I have dwelt on these matters at some length because frustrations arising from regulations that are useful in other types of work have completely ruined the morale of half the government laboratories of the world. It would be better for a government not to establish a research laboratory than to set up one bound hand and foot by red tape. It will finish up with a staff composed mainly of those who put security before achievement, with a sprinkling of those so convinced of the importance of their work that they will endure almost anything to carry on with it.

Please do not imagine that these remarks are directed at anybody in New Zealand. Though I hope to see something of your laboratories in the next few weeks, I know next to nothing about them now, and have not the least idea how successful you have been in overcoming the difficulties to which I have referred. Perhaps I can leave the subject with the remark that often the skilled research man has the temperament of the artist, and that if you want the best from him you must provide adequate facilities, no regulations, and above all no direction. You must judge him by what he accomplishes over a period of a year or more, and not by what he is doing on this day or that. One of the most successful research men of industry whom I have known often arrived for his day's work as the rest of the staff was leaving. For the man who produces exceptional results, I think you will agree that exceptional latitude is fully warranted.

You may be interested to know some of the ways in which my own Division of Australia's C.S.I.R.O. is attempting to help secondary industry. First let me mention work done to assist two industries which may be described as traditional, the foundry and fellmongering industries. Most of Australia's foundries are small and rely on rule-of-thumb methods for control of their products. Even overseas, foundries have been slow to adopt scientific methods. We began by showing how the moulding operation can be better controlled by taking greater care in selecting and testing the sand used for the moulds. We have demonstrated by suitable standard tests that the sand can be kept in such a condition that the castings are better and the number of rejects can be cut down very considerably. In conjunction with the Mines Departments of all the mainland States, we have surveyed and tested all sand deposits within easy access of the foundries, and have recommended which deposits are suitable for the different types of moulding. We have recommended blending where it would be helpful, and have given advice in scores of instances where foundry operations have gone awry. This is very practical work, not in any way fundamental, but it is what the industry most needs at present. More basic research can come later.

Over a period of years our Biochemistry Section has made a scientific study of the operations the fellmonger employs to recover wool from sheepskins. Some fellmongers were sceptical whether within a few years the scientist would be able to find out enough about their industry to be able to suggest improvements in processes that had evolved over countless generations. While a few sceptics remain, the industry as a whole was so impressed by the work done that, within a few years, it imposed a voluntary levy to provide additional finance for the work, and at the present time several companies are testing on a large scale some of our proposals for improving fellmongering operations. We are usually consulted about the design of new fellmongery buildings. There has been a nice blend of pure and applied research in our work for that industry.

The Biochemistry, Chemical, Physics and Organic Chemistry Sections are all making substantial contributions to the Organization's wool research programme. The first two are studying the ultimate composition of the wool fibre and attempting to find out how it is produced by the sheep. The knowledge acquired may be expected to find application in improving the properties of the fibre for the textile trade by chemical or physical treatment, and in fellmongering—for in the latter the aim is to separate the wool from the pelt at the site of generation of the fibre with as little damage as possible to either.

Australia's sheep produce 50,000 tons of wool wax each year. Some is recovered in the scouring operation, but much runs to waste. Lanoline is the best-known product, but a high-priced chemical, cholesterol, is now made from it in appreciable quantity. Our research men are now striving to identify and separate all the constituents of the wax, to study their properties, to form new and more valuable compounds from them. From such studies it is hoped that there will develop a new branch of the fine chemicals industry based on wool wax, and that the low price now paid for it will be doubled or trebled. One cannot guarantee success in such fields as this, but I regard this work as a very good business gamble. Two years ago another Section (that of Physical Chemistry) began a fundamental study of the operations involved in scouring, and already a very promising practical application has become apparent, which will be tested shortly on a pilot plant scale.

The Organic Chemistry Section, in conjunction with the Division of Plant Industry of C.S.I.R.O. and several university departments, is making a study of the alkaloids present in indigenous trees and shrubs. This is a big project, which may last a hundred years, and it is hoped that from time to time alkaloids of value in medicine will be found. Might I remind you that the alkaloid quinine comes from the bark of cinchona, a native of South America, and that the drug hyoscine, produced from **Duboisia myoporides** in Australia to meet wartime shortage, is still in commercial production. A more practical project is connected with an alkaloid present in the weed Heliotropium europaeum, which is responsible for the loss of many sheep.

There is scope for a vast amount of valuable work by the Minerals Utilisation Section, whose aim is to discover uses for Australian minerals not now exploited, to determine how best to produce concentrates or chemical intermediates from recognised economic minerals, and to carry the processing of minerals further before they are exported. It is a fascinating field and the main problem has been to select the most promising projects from among the many that might have been tackled. During the war the Section showed how to treat certain Australian minerals to replace those formerly imported as, for example, graphite and manganese ores for use in the dry cell industry, local chromite to replace that from New Caledonia if it should have become necessary. The Division has also helped in evolving methods for manufacture of potash fertilisers from the huge clay-like deposits of alunite in Western Australia, where a plant is now operated by the State Government.

The sea beaches near the border of Queensland and New South Wales are rich in certain heavy minerals carried downstream from the old mountain ranges, and concentrated in and under the sand dunes by wave and wind. In the aggregate the quantities available are enormous—there are no richer deposits in the world. The minerals contain two elements, titanium and zirconium, which until a few years ago were but little used, or even thought of. It seemed that in these deposits Australia had a potential source of riches, provided that uses were found for the two metals and their compounds with other elements. Accordingly one of the first projects of the Mineral Utilisation Section was the sudy of the beach minerals, and some success has already been achieved. The whole world has now become interested in them, but we take pride in our early appreciation of their importance.

Minerals also form the basis of the cement and ceramics industries. Our work on cement has been supported financially by the cement manufacturers, at first for a trial period of five years, and subsequently for a second five years. Costly cracks have developed in recent years in some large concrete dams in America, due to delayed chemical action between cement and the selected sand or "metal," and the first project of the new Section aimed both to prevent similar failures in Australia and to study the chemical reactions responsible for them. Though the project is by no means completed, considerable success has been achieved with both aspects of it. There need be no failures of this type in large concrete structures in Australia if those responsible consult us about the selection of the sand and metal, and as the work is now well-known, we are usually consulted.

The ceramics industries — those based on clay — use a variety of minerals in their wide range of products. Over the centuries suitable grades of minerals and of clay have been found in England, and the potteries can purchase what they need without much trouble. It is different in Australia, where the search for suitable deposits has been somewhat haphazard, and, in any case, is in its infancy. So we are making a search, in collaboration with the Mines Departments of several States and the University of Melbourne, for suitable raw materials for the industry. This will take a very long time to complete, but there will be many interim dividends.

Failure of refractories in service is very costly; in collaboration with the gas-making industry and the cement industry, we are endeavouring to find the causes of failures, and to point the way to better products.

The Physical Chemistry Section has a project of long standing, which aims to help the mining and metallurgical industry. One of the operations of ore-dressing — the flotation process — is under investigation from two different angles. In the first place we are trying to get a clearer understanding of the physical and chemical principles underlying the process; in the second, we are trying to apply these principles to improving the methods of the flotation of scheelite, cassiterite and other minerals.

Australia is not alone in having many problems in connection with the utilisation of its coal. Perhaps the most important arises from the fact that no deposits of oil have been found, and ultimately we may be forced to produce liquid fuels from coal. We cannot expect the rest of the world to solve these problems for us, for our coals differ from those of England and U.S.A., and the methods that give the best results in those countries will certainly need modification. Work has therefore been commenced in our Chemical Engineering Section on the production of "synthesis gas" from low-grade coal, of which we have an abundance. Synthesis gas is a mixture of carbon monoxide and hydrogen, and when we have determined how to make it as cheaply as possible we can use the results of overseas research to convert it to liquid fuels and other organic chemicals by the Fischer-Tropsch process. For although our coals differ from those of other countries, synthesis gas is the same wherever it is produced.

In this same Section we have set up pilot plant equipment for most of the processes employed by the chemical engineer. This is used primarily for pilot plant work on processes developed by other Sections. It is available also as an aid to industry and is freely used for this purpose. Companies are often saved the necessity of installing pilot plant to test a proposed process or a plant modification, which saves them both time and money.

In another Section, that of Chemical Physics, we are using the most modern techniques of physics in the solution of chemical problems. Naturally such a Section, which has an impressive array of equipment, is called upon by other parts of C.S.I.R.O., by the Universities and by Industry to assist in the solution of problems to which the methods of the chemical physicist are particularly suited. It also has its own research projects, one of which, on wool and proteins, I have already mentioned. It is also interested in the study of the luminescence of solids, a subject of great value to the lighting industry.

As the work of a laboratory of the type I have briefly described becomes better known, research workers come to it to learn techniques or to use its facilities. There are indications that this will become one of the most important functions of our Division of Industrial Chemistry, which has had as many as half a dozen guest workers at once. Some stay only for a few weeks, but others have remained for a year or longer. I would suggest that a major function of the Government laboratory is to provide facilities which can be used, under supervision of course, by visitors from industry or educational institutions. The benefits to those using the facilities are obvious. The laboratory also benefits from intimate contact with men of differing interests.

In our work for any industry we believe that it is an advantage to make our research as fundamental as the state of development of that industry permits. Different industries vary greatly in the extent to which they use scientific methods, and there is therefore a wide variety and depth of work in a laboratory which caters for several industries. I want to conclude my remarks by emphasising that in my opinion neither pure nor applied research is superior to the other. Both are essential. Two different types of men are needed for them, and again both types are essential. I consider that each type gains tremendously from close association with the other, provided their work is in the same broad field, and that the money spent by Governments on research will pay the richest dividends if these principles are recognised.

IMPORTANT NOTICE

LIST OF MEMBERS

Council has decided that the list of members will be published in future at two-yearly intervals, and it is hoped to begin work on the next issue very shortly. Members should therefore examine the entry referring to them in the current list, and if any alteration is necessary please advise the Editor, P.O. Box 12, Newmarket, by October 31st. If this is not done, no responsibility can be taken for any inaccuracies in the new list, though every effort will be made to avoid them.

THE CONTRIBUTION BY NEW ZEALAND WORKERS TO THE CHEMISTRY OF PLANTS: PART II. INVESTIGATION OF THE NATIVE FLORA.

J. MURRAY, University of Otago, Dunedin.

The chemistry of the New Zealand Flora has been studied more or less continuously since about 1860, but only within the last few years has any very systematic work been done. In the past, the usual scheme has been to select some particular plant for its essential oil or alkaloid content and identify as many of its chemical constituents as convenient. Practically nothing is known as to the variation in chemical composition of any particular plant with respect to season or habitat; nor is much information available concerning the chemical inter-relationships of related plant species. However, it seems likely that some of these defects will be remedied in the fairly near future.

In the early period, from 1860 to about 1910, the research on the native flora was carried out by a few enthusiasts, notably W. Skey, T. H. Easterfield and B. C. Aston. Latterly, the major part of the research work has been carried out at the University Colleges, particularly at Auckland and Otago, and mostly by students doing practical work for the M.Sc. degree. Consequently, there have been few long-range investigations, and the subjects studied have usually been such as might be conveniently completed in about a year. With the institution of the Ph.D. degree, and the availabilty of newer chemical methods and apparatus, we can now expect to see the appearance of more detailed and more comprehensive work.

The only group of plants which has been reasonably well investigated is that of the pines, although even here there are serious gaps in our knowledge, and recent work indicates that their chemistry is more complex than has previously been suspected. In this group the investigations have dealt almost entirely with the essential oils, and to a lesser extent with the diterpenoid compounds found in the woods of certain species. At the present time, a comprehensive investigation of the colouring matters of the members of the **Coprosma** genus is in progress.

The subject matter of this survey will be arranged according to the nature of the chemical compounds obtained from the flora, rather than according to the botanical classification of the plants concerned.

ESSENTIAL OILS

The majority of the New Zealand plants have now been investigated for esential oils, but very few have been given a detailed study. This is partly due to difficulties of supply, but more important is the difficulty in separating the essential oils into their components. In the past, this was done by distillation, using ordinary laboratory-type fractionating columns with an efficiency of, at most, only a few theoretical plates. Hence the separation of a reasonably pure compound usually required repeated fractional distillation, with consequent losses of material. Since relatively small amounts of oils were available, it was normally only possible to identify the major constituents of them.

Since 1945, however, with the construction of highly efficient fractionating equipment at Auckland and Otago Universities it has become possible to make nearly complete analyses of several essential oils. Already a number of interesting facts have emerged and it has been found that the oils are much more complex than has previously been thought. For example, when the essential oil of Silver Pine (**Dacrydium colensoi**) was fractionated by Blackie (1928) only two constituents were identified, but when the work was recently repeated, nine were isolated. Another point which has become evident is that the chemical composition of the plant may vary markedly with season and habitat. Whether the variation with habitat is due to varietal differences in the plant species remains to be determined. Both these effects have been observed for some time in the case of the Australian oil-producing flora, but have not previously been noticed in New Zealand. It is obvious that the whole question of variation in the chemical composition merits thorough investigation.

The most interesting work to date has been carried out on the New Zealand pines, of which there are twenty species distributed among five genera. All those so far investigated, sixteen in number, yield from 0.1 to 2% of oil, and in all probability the remaining species also contain essential oil.

These oils regularly contain 3-70% of terpenes, $C_{10}H_{16}$, together with small amounts of terpene alcohols, aldehydes and esters, generally about 40% of sesquiterpenes, $C_{15}H_{24}$, and varying percentages of diterpenes, $C_{20}H_{32}$. The terpene fractions invariably contain α-pinene, the most widely distributed of all terpenes.

Blackie reported "dacrydene" in place of α-pinene in the oil of Silver pine, but a more recent investigation has shown the main terpene to be d-α-pinene. The laevorotatory form has been found more rarely.

It is probably significant that the isomeric β-pinene has been found in the oils of all the five **Podocarpus** species so far examined, but does not occur in any member of the closely related genera **Dacrydium** and **Phyllocladus**, and apparently is not produced by **Agathis** (Kauri) or **Libocedrus** (Cedar).

It is probable that the terpenes limonene (or the optically inactive form, dipentene) and myrcene are also common to the whole group. Although myrcene has only occasionally been reported, repetition of previous analyses has always shown this substance to be present in small amount (mostly unpublished work). In a few species the presence of additional terpenes has been established, e.g. sabinene in the cedar and camphene in the Kauri.

Although the terpenes of New Zealand pines are reasonably well-known, the sesquiterpenes remain an almost unexplored field. The major factors which have hindered the study of sesquiterpenes, not only in this country but overseas, are firstly the extreme difficulty in separating them by fractional distillation alone and the instability of some of them under heat treatment, and secondly the reluctance with which they form identifiable crystalline derivatives.

In many cases, sesquiterpenes have been shown to form azeotropic mixtures, and attempts to break these up have been fruitless. Some method of separation other than distillation will probably be necessary for further progress in sesquiterpene chemistry. (In addition, like the terpenes, they may undergo extensive molecular rearrangments under quite mild chemical operations.) In only two pine oils have constituents other than cadinene been identified.

Briggs and Sutherland (1947) have demonstrated the presence of the tricyclic sesquiterpene copaene in the essential oil of the Tanekaha (**Phyllocladus trichomanoides**).

One of the most complete analyses of an essential oil is due to Batt, Hassall and Slater (partly published, 1949), who have separated the oil of the cedar (**Libocedrus bidwillii**) into about fifteen individual compounds and identified eleven of these. Besides cadinene, two other sesquiterpenes were characterised, namely α-caryophyllene and a new member of the group, d-γ-curcumene. The structure of the latter has been elucidated by the standard methods used in this field, i.e., dehydrogenation with selenium or sulphur, and ozonolysis. Dehydrogenation of the sesquiterpene yielded cadalene and another hydrocarbon which may be 6-p-tolyl-2-methyl heptane, while oxidation with ozone gave acetone and γ-p-tolyl-n-valeric acid.

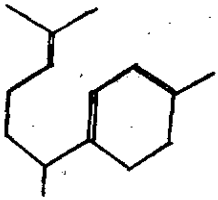
Derivatives of other sesquiterpenes have occasionally been obtained from New Zealand pine oils, but in no case was adequate identification possible. Oxygenated sesquiterpene compounds are present in some of these oils, but practically nothing is known about them.

Much the most interesting feature of the native pines is that with one exception (the cedar) the highest-boiling fractions of their essential oils yield crystalline diterpenes, apparently all closely related in structure. The same substances or members of the same group have been obtained from a few pines in Australia, Netherlands East Indies, Phillipines and Japan, but New Zealand is the main source of diterpenes. Pines in other parts of the world, even related species, apparently do not produce these diterpenes. Liquid diterpenes have sometimes been reported, but it is highly probable that they are merely polymerisation products of the terpenes, obtained during the heat treatment involved in the distillation of the oils. It is interesting to note that the Monterey cypress or Macrocarpa (**Cupressus macrocarpa**) growing in New Zealand was found to give an oil containing two solid diterpenes (1942). Presumably the tree produces the same constituents in its native habitat (California), although this has not been checked.

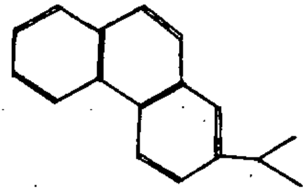
The first of these diterpenes to be discovered was phyllocladene, isolated in 1910 from the Tasmanian pine **Phyllocladus rhomboidalis.** By 1935, several of these substances were known, namely "dacrene" from New Zealand **Dacrydium** species, "sciadopitene" from a Japanese pine, rimuene from rimu and totara, podocarprene from a Japanese **Podocarpus,** mirene from Miro, kaurene from the kauri, and "isodacrene" an isomerisation product of dacrene. Comparatively little progress was made with the chemistry of the diterpenes until after 1937, when Brandt showed that dacrene and sciadopitene were identical with phyllocladene. The key substance of the group is isophyllocladene, which is obtained by isomerising phyllocladene and rimuene with alcoholic sulphuric acid, the change involving a shift of a double bond and a cyclisation respectively. It is now known that kaurene is l-podocarpene identical with that from the Japanese source, while mirene is mainly d-podocarprene obtained also from Matai oil. Isophyllocladene has been isolated from some of the oils, but is probably produced from the primary phyllocladene by isomerisation during the treatment of the material. Until recently the occurrence of the diterpenes was thought to be as follows: Phyllocladene is produced by the four Dacrydium species examined, although species of the same genus outside New Zealand apparently do not contain it. **Dacrydium cupressinum.** (rimu) yields rimuene in addition to phyllocladene. Phyllocladene is also obtained from the Phyllocladus species, and among foreign plants, from the Norfolk Island pine (**Araucaria**) and the Japanese pine, **Sciadopitys.** Phyllocladene is the diterpene component of the oil from the totara (**Podocarpus hallii**) which appears to be the only Podocarpus species to give it.

Isophyllocladene has been separated from the oils of Tanekaha (**Phyllocladus**), Norfolk Is. pine and Marcrocarpa.

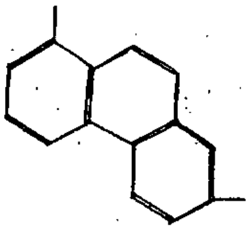
Three **Podocarpus** species yield podocarprene (miro, matai and P. macrophylla), and this diterpene is obtained also from kauri (**Agathis**). Of the remaining Podocarpus species Kahikatea possibly produces podocarprene,



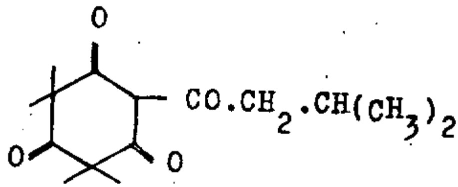
d-γ-curcumene



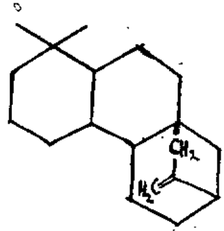
retene



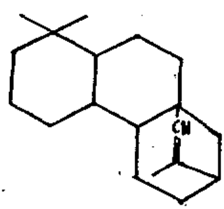
pimanthrene



leptospermone



phyllocladene



isophyllocladene

while totara (**P. totara**) is anomalous in giving an oil containing rimuene (1933). This is particularly remarkable since the two species of totara are very similar botanically and even appear to hybridise readily. However, some complications have appeared in this picture. In a later investigation of the Matai (**Podocarpus spicatus**) no podocarprene could be obtained. A sample of the rimuene-yielding totara used by Beath (1933) which had been preserved, is more nearly allied to **Podocarpus hallii** than to **P. totara**, and furthermore, distillation of material collected in the same locality in 1946 gave an oil containing only phyllocladene. An adequate explanation of these discrepancies yet remains to be found.

The members of the diterpene group which have been most closely studied are phyllocladene and isophyllocladene, and partial structural formulae have been proposed for these isomers by Brandt (1946). Considerable difficulty was experienced by earlier workers in identifying the products of dehydrogenation, and a previous formulation of phyllocladene by Nishida and Uota (1936) was largely based on the erroneous characterisation of the dehydrogenation product as 1-isopropyl-7-methylphenanthrene. Brandt (1938), however, was able to show that selenium dehydrogenation yielded a mixture of retene and pimanthrene. It is worthy of note that in this series of compounds melting points and mixed melting points are a very unreliable guide to either identity or purity of the substances.

Phyllocladene has one ethylenic link, so is tetracyclic. On hydrogenation it gives the same two isomeric dihydro compounds as does isophyllocladene and one of them is identical with iosene, a saturated hydrocarbon obtained previously from European lignites. They also yield the same addition compound with hydrogen chloride. From oxidation experiments, Brandt has obtained information regarding the molecular structure in the immediate vicinity of the double bond, and the remainder of the skeleton has been filled in in accordance with the isoprene rule. Much more work remains to be done in this field however; the phyllocladene structure for example contains five assymetric carbon atoms, and nothing is yet known about their configurations.

The remaining diterpenes have not yet been so fully investigated but show an essential similarity to phyllocladene and undoubtedly have similar structures.

The cedar **(Librocedrus bidwillii)** is unique among the New Zealand pines in yielding an oil containing no diterpene constituent, but in its place a mixture of solid paraffins. No paraffins have been obtained from any other New Zealand pine, although it is quite likely that they may be present in small amounts. It is perhaps worthy of note that a large number of native plants produce paraffin wax although usually only in traces; this applies even to those which do not yield a measurable amount of essential oil.

A complete investigation of the essential oils of the New Zealand pines can be expected to provide useful information bearing on their botanical classification. It would be interesting to know whether, for example, the occurrence of the same diterpene in kauri and matai indicates a closer relationship between the two plants than is to be expected from their classification in two plant families which are apparently only distantly related to each other. At present the totara **(Podocarpus hallii)** is the only Podocarpus species known to yield phyllocladene, and it will be of interest to analyse the oils from the two members of this genus which have not yet received the attention of the chemist.

Excepting the pines, there are very few groups of plants in New Zealand noted for the production of essential oils. The largest such group comprises the members of the Myrtaceae family, but except for the manuka, it has received no detailed study. In Australia the family includes such important oil-bearing trees as the Eucalyptus, but it would be premature to suggest the possibility of commercial uses for the oils of the New Zealand members of the family.

The manuka **(Leptospermum scoparium)** gives a fair yield of oil essentially similar in character to those of several Australian species which are produced on a commercial scale. It contains α-pinene, geraniol and citronellol (mainly as esters), citronellal and citral, sesquiterpenes similar to eudesmene or aromadendrene, and a ketonic compound, leptospermone, of unusual structure. This latter substance has acidic properties and until recent research by Briggs, Short and Hassall (1938, 1945) was named leptospermol and thought to be a phenol. Oxidation of the substance with permanganate yielded diisopropyl ketone and isovaleric acid, while hydrolysis with hydrochloric acid gave tetramethylphloroglucinol. Mainly on this basis the structure shown has been assigned to leptrospermone, and this has been verified by synthesis (Briggs, Hassall and Taylor, 1948).

The most notable feature of the structure of leptospermone is the fact that it does not follow the isoprene rule, i.e., it cannot be made up from isoprene units C—C—C—C joined head to tail. It is characteristic of many

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C—C—C—C
    |
    C
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natural products, particularly those derived from essential oils, that their structures may be built up in this way. It is obvious that this property has some connection with the manner in which the substances are synthesised by the plants, but attempts to prove various schemes of biosynthesis have not met with much success.

A closely related species, **L. ericoides**, produces an essential oil of the same type (Short, 1923).

A survey of the New Zealand **Metrosideros** species (the ratas) has been made by Gardner (1931) and a more detailed examination would be of much interest both chemically and botanically. The species appear to fall into two groups on the basis of the chemical examination, one yielding essential oils containing terpenes and sesquiterpenes together with oxygenated compounds, and the other giving oils containing only sesquiterpenes. The main sesquiterpenes in all species seem to be the same, or at least very similar. This sesquiterpene or group of sesquiterpenes yield cadinene hydrochloride, although cadinene itself is apparently not present. Separation of the species into two groups chemically is not paralleled by any corresponding botanical differences, and it would seem profitable to repeat this work using larger quantities of material and more modern methods of analysis.

The remaining essential oil-bearing plants comprise mainly single unrelated species as follows:

Pittosporum species: Two of these have been examined in detail (by Carter, 1949), and are mainly remarkable in being chemically quite unrelated; in fact the only constituent common to both is the terpene limonene, a substance common to most essential oils. **P. eugenioides** is remarkable in yielding n-nonane, a substance found only very rarely in plants. Apart from sabinene, limonene and high molecular weight paraffins, the other constituents have not been identified. It is known that one or two foreign **Pittosporum** species produce paraffin hydrocarbon, e.g. n-heptane. The other species, **P. tenuifolium**, produces a "normal" essential oil containing α- and β-pinene, myrcene, terpinene, and bornyl acetate, at least one new sesquiterpene, and solid paraffin wax. Several other species yield essential oils but in amounts too small to be investigated.

Macropiper excelsum (Kawakawa). The essential oil of this tree (Briggs, 1941) contains the aromatic ether, myristicin, as major component, together with an unidentified alcohol and two or more sesquiterpenes.

Pseudowintera colorata (Horopito). This is an interesting plant from the chemical point of view, and investigation of several of the substances produced by it is currently proceeding. The essential oil was studied by Melville, Levi, Birrell and others (1926-48) and to date at least eighteen chemical individuals have been isolated from it. The oil is particularly rich in sesquiterpenes giving on dehydrogenation either cadalene or the intense blue hydrocarbon, guaiazulene, and several of them are believed to be new compounds. Melville and Birrell used the azulene from Horopito oil in their work on the structure of the hydrocarbon (1933-5).

A preliminary examination has been made of the closely related species **P. axillaris**, which yields an oil of similar character.

Phebalium nudum (Mairehau). The leaves of this tree were used by the Maori for perfumery purposes, and the sweet scent of the plant is due to an essential oil shown by Radcliffe and Short (1928) to contain terpinyl acetate, limonene, camphene, citronellal, citral, unidentified sesquiterpenes and oxygenated compounds.

Melicope ternata and **simplex** contain small amounts of essential oils, the first of which has received a partial analysis by Radcliffe.

Nothopanax and **Pseudopanax** species. Several of these yield essential oils, and one of them has been investigated in detail by Stanley and Murray. The principal components are myrcene and a mixture of paraffin hydrocarbons.

Myoporum laetum (Ngaio). This oil is most unusual in that it shows a complete absence of the normal terpenic compounds, except for a small amount of sesquiterpene. Over 80% of the oil consists of ngaione, $C_{15}H_{22}O_3$, which has been shown by McDowell (1925-8) and Ross and Brandt (1945) to be related to furane. It contains one ketone grouping, and the other oxygen atoms are present in furane or reduced furane rings. The same substance is present in one Australian **Myoporum** species, while another contains a similar ketone with an additional oxygen atom. The Ngaio, like most other **Myoporum** species, is poisonous, but this is apparently not entirely due to the essential oil.

Olearia paniculata. The essential oil of this plant (McLean, Slater, Murray, 1945) contains several terpenes and sesquiterpenes not yet completely identified, together with a diterpene oxide, $C_{20}H_{34}O$. The occurrence of such substances in essential oil is very rare, and normally they are only found in the pines and a few other unrelated plants. This substance, olearyl oxide, is probably similar in structure to manoyl oxide which will be mentioned later. A few other Olearia species yield oils, but in small amounts only. **O. ilicifolia** is notable in producing an oil containing paraffin hydrocarbons and a paraffin alcohol together with the usual terpenes and sesquiterpenes.

A number of other New Zealand plants are known to yield essential oils which have as yet been very incompletely studied. The investigations in many cases are hampered by poor yields, and by scarcity of the plant material.

In concluding this section, it might be appropriate to point out some of the directions which future research in this field may take. The first necessity is to elaborate better methods for analysing oils and for purifying the constituents. The use of improved distillation apparatus is by no means a sufficient answer to this problem, since as has been already noted some of these substances form inseparable azeotropes, while others may be decomposed or altered in structure by the heat treatment involved. It is likely that other selective methods of separation involving adsorption on alumina or silica gel, or the use of the Craig counter-current liquid-liquid extractor, may yield useful results. Secondly, much of the chemistry of the terpenic compounds yet remains to be elucidated. Frequently they show very facile but extensive changes in molecular structure under chemical treatment, and the use of newer physical methods, notably infra-red spectroscopy, will be of service in checking the conclusions reached on purely chemical evidence. Thirdly, there is very little known at present about the variation in composition of plants. It would be very useful to make an exhaustive study of some particular species (e.g. manuka), with a view to determining the composition of the essential oil from trees in various parts of the country, and at different seasons. It may even be possible to follow the change in chemical composition of an individual tree from day to day, using the techniques of microchemistry, and this will be necessary to further our knowledge of the mechanism by which the essential oils are synthesised.

THE STATUS OF SILICON CHEMISTRY

C. J. WILKINS

(Summary of Chairman's Address to Canterbury Branch, March 1949.)

Certain features of silicon compounds, in particular the variety of silicate minerals, the considerable and diverse reactivities of the halides and hydrides, together with the stability and ease of formation of the organic derivatives, have stimulated a rather full investigation of the chemistry of the element. Indeed the more recent advances in the chemistry of silicon have perhaps been surpassed only by developments in the chemistry of the trans-uranic elements.

Up to 1920 practically nothing was known as to the reasons underlying the diversity of the natural silicates. It was only then that Sir Lawrence Bragg began his classical researches on the atomic arrangements within these substances. Important work on silicon halides and organics had been carried out very much earlier by some of the most able chemists of their day—Freidel, Crafts and Ladenburg. In 1904 Kipping applied the newly discovered Grignard reagent in place of zinc alkyls for synthesising silicon organics. Kipping's life-long work in this field is impressive, and in 1936 he himself considered that he had almost exhausted the opportunities, though he was largely concerned with comparisons between silicon and carbon. Compounds of the two elements are certainly very different. There is often a similarity in compositions of corresponding compounds, but not in reactions or reactivities. Silicon is one of the border-line non-metals whose hydrides are not very stable and whose oxy-compounds are polymeric. Moreover, silicon halides are readily susceptible to hydrolysis and ammonolysis. For such reasons we find that silicon more closely resembles boron and tetravalent germanium.

Renewed interest was, however, arising at this stage. Important developments occurred almost immediately and during the past few years the field pioneered by Kipping has blossomed to the full. Since about 1943 there have been about thirty papers a year on silicon chemistry in the Journal of the American Chemical Society alone, much of this work coming from the industrial laboratories of the U.S.A. where investigations have been stimulated by technical applications, proved and potential, of the silicone oils and resins. From an academic viewpoint the silicones are of interest as providing a link between the monomeric halides, hydrides and organics, and the polymeric oxy-compounds.

The most important silicon compound is the dioxide, notable for existing as an exceptionally stable high polymer. In accordance with the structural principle that co-ordination numbers tend to be as high as possible in crystals of ionic and highly polar compounds we find that each silicon atom is surrounded tetrahedrally by four oxygen atoms; and each oxygen is linked to two silicon atoms. This arrangement extends indefinitely in three dimensions so that every bond contributes to the stability of the polymer. In the glassy form of silica there is a disorderly arrangement of atoms due to variations in bond angles. The simple SiO_2 molecule is unknown unless it exists in the vapour.

The structural plan of many of the silicates is closely related to that of the oxide. We invariably find SiO_4 tetrahedra, but the degree of condensation is not usually as great as in silica itself. The degree of condensation necessary to produce 4-co-ordination depends upon the O:Si ratio—that is, upon the composition of the magma from which the silicate has crystallised. From the most basic melts there crystallise minerals such as olivine, in which there is no condensation of SiO_4 tetrahedra. Between olivine and silica there occur all intermediate degrees of condensation as the O:Si ratio falls from 4:1 to 2:1; we find rings and short chains, long chains, ribbons, sheets and three-dimensional networks. Further, the variety of silicates is diversified by isomorphous replacement of silicon by aluminium in these polymeric anions. Other non-metals do not form polymeric anions on the same grand scale, and in explanation of the rapid decrease in this tendency on passing from silicon to chlorine Pauling suggests that electrostatic potentials become decreasingly favourable (the "electrostatic valency rule").

The silicates whose structures have attracted most attention of recent years are those having layer lattices, including the clay minerals and micas. The hydroxide and oxide ions present in these structures are of similar size and the layers contain three or four sheets of these units held in close packing by the interstitial cations. The layers may be neutral as in the clay minerals or negative as in the micas.

The synthetic silicones contains the silicon-oxygen chain so important in Nature, but modified through replacement of the lateral oxygens by unreactive organic groups, thereby eliminating primary valence forces between the chains. These substances combine in some measure the thermal stability of silicate structures with the water-repellant property, chemical inertness and electrical properties of the hydrocarbons. The methyl silicone oils contain the unit $SiMe_2O$ repeated about ten times, the chain being terminated by $SiMe_3$ groups. The temperature coefficient of viscosity of such oils is very low. At low temperatures the chains are coiled and move over one another rather freely, but as the temperature rises the chains uncoil and the increased van der Waals interaction counterbalances the more violent molecular movement. Long chain silicones are rubbery, limited cross-linking of short chains produces a grease, and more extensive cross-linking a resin.

```
        R3Si — O — SiR — O — SiR2 — O — SiR2 —
                    |
                    O
                    |
— SiR2 — O — SiR — O — SiR2 —
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Cross-linking and termination of silicone chains.

These various chain molecules form spontaneously when mixtures of the appropriate organo-substituted chlorides are hydrolysed. The chains are unreactive towards most chemical reagents, though they are degraded by concentrated sulphuric acid, and are completely disrupted by hydrogen fluoride as in the case of silica itself.

We have seen that the diversity of silicon-oxygen compounds arises from atomic arrangement. Turning to its volatile compounds we find silicon linked to a wide variety of other atoms and consequently these compounds must be considered primarily in terms of reactions. The important classes are the hydrides, halides and organics, together with a remarkable range of mixed types easily produced from the primary types by stepwise substitution. Silicon hydrides have low thermal stability and are very sensitive to oxidation. The tetrahalides are readily obtained but the higher halides remain inaccessible. Organic derivatives are notable for the stability and ease of formation of the carbon-silicon bond.

Of the numerous methods available for establishing carbon-silicon bonds it seems that two are in use on the technical scale for the production of silicone intermediates. One involves the interaction of a Grignard reagent with silicon tetrachloride, the other the reaction of an organic halide with copper-silicon alloy (10% Cu).

This last reaction probably affords the most satisfactory of all methods for synthesising R_2SiX_2 (where X = Cl or Br). Derivatives of the type R_3SiX are obtained in high yield by allowing a Grignard reagent to react with silicon ortho ester and converting the resulting ethoxy compound to the desired halide with halogen ion and concentrated sulphuric acid.

Reactions of silicon halides with reagents other than those which produce carbon-silicon bonds are receiving no less attention. We may select a few examples.

It has recently been demonstrated that the hydrolysis of silicon tetrachloride is a stepwise reaction from which hexachlorodisiloxane can be isolated as an intermediate.

$$2SiCl_4 + H_2O \rightarrow Cl_3Si.O.SiCl_3 + 2HCl$$

From the reaction between trimethylchlorosilane and ammonia there is produced an analogous silazane.

$$2R_3SiCl + 3NH_3 \rightarrow R_3Si.NH.SiR_3 + 2NH_4Cl$$

Reactions with tertiary amines are not attended by elimination of hydrogen chloride. Trimethylamine reacting with silicon tetrafluoride yields the expected 2:1 co-ordination complex together with an unusual 1:1 complex. Reacting with silicyl chloride it gives a quaternary ammonium salt.

$$SiH_3Cl + NMe_3 \rightarrow [H_3Si.NMe_3]\cdot Cl$$

Redistribution reactions occur with moderate ease. Silicon tetrachloride and silicon tetraiodide readily yield a mixture containing the three chloroiodides in proportions indicating a random distributon of halogen atoms as is usually, though not always, the case.

Most of the reactions shown by silicon halides are common to other covalent halides, but have not been so fully investigated elsewhere. Indeed in the writer's view the chemistry of silicon is better known than is the chemistry of any other non-metallic element, excepting carbon.

NEW BOOKS

Colorimetric Methods of Analysis. 3rd Edition. Vol. I. Theory. Instruments. pH. By Foster Dee Snell and Cornelia T. Snell, New York. 239 pp. 1948: New York, D. Van Nostrand Co., Inc., $4.50; London, Macmillan and Co. 25s.

The first volume of this useful book, which also deals with nephelometry and turbidimetry (one chapter each), is being published in two volumes in this edition. The space devoted to the topics in this volume has been increased by over one-third. The most notable changes are in the enlarged treatment of photoelectric methods and photometry generally. New chapters have been added on spectrophotometry and fluorimetry, neither of which is referred to in the second edition, and the whole volume has been thoroughly revised. This work can be recommended to anyone interested in colorimetry. It reviews all the instruments and methods, and gives tables on artificial standards, spectral transmission lines of filters, indicators and colorimetric readings for the various indicators. It is profusely illustrated and has both author and subject indexes.

Surface Active Agents. By Anthony M. Schwartz and J. W. Perry. 579 pp. 1949: New York and London, Interscience Publishers, $10.00.

Surface active agents is a field of chemistry of fast growing importance, partially due to the shortage of fats as raw materials for the old-established detergents, and partially because of the intrinsic merits of these new products. It is therefore very useful to have an up-to-date and well-informed treatise such as this volume. It is divided into three sections, the first outlining the different surface active agents according to their type and chemical structure. A very large number of products are mentioned and their structures given, and as far as American work is concerned, the list seems to have been very complete at the time of printing. The same may apply to the German compounds too, but the Lissapols are only just mentioned, and are not indexed. The second section, "Physical chemistry of surface active agents in theory and practice," does quite well on a topic which is still somewhat confused, and collects much otherwise scattered information. The final section (120 pages) deals with practical applications under various headings. In the reviewer's opinion, this section could with advantage be considerably enlarged and the value of the book still further enhanced, without its becoming unwieldy. It does however list most of the applications without much detail. Definitely a useful book, particularly to the industrial chemist.

The Chemistry of Penicillin. Edited by Hans T. Clarke, Columbia University, John R. Johnson, Cornell University, and Sir Robert Robinson, Oxford University. 1094 pages. 1949. Princeton University Press. (London: Geoffrey Cumberlege, Oxford University Press.) £9 9s.

This is an unusual book in that, apart from a few pages of historical matter, the whole of its eleven hundred quarto double column pages are devoted to original research done in Britain and United States from 1942 to 1945 with the object of discovering a synthetic method of producing penicillin in quantity. The controlling authorities were the Office of Scientific Research and Development, Washington, and the Medical Research Council, London, and the work was carried on in nine universities, five medical research institutes, four government and seventeen industrial laboratories. Reports from these various workers were exchanged without restriction, but for military reasons results were not published at the time. It has now been decided to communicate them in the form of a monograph because of the burden which would be placed on the various journals and, as the preface rather ponderously puts it, "the irreversibility of the interdigitation of the researches of the collaborating groups made it impracticable to assign individual achievements to individual investigators."

The book contains 29 original papers produced in the same style as those in the "Journal of the American Chemical Society," with full experimental details, the culminating effect being the production of a few milligrams of synthetic benzyl penicillin by du Vigneaud and co-workers at Cornell. Because of its very size and the wide co-operative basis of this piece of directed research, it has a much wider philosophical significance than isolated papers on the same topic would command, but to chemists outside the field of antibiotics, the price would seem a little high.

Traité de Chimie Organique. Published under the direction of V. Grignard, G. Dupont, R. Loquin and Paul Baud. Vol. XV. 815 pages. 1948. Paris: Masson et Cie, 120 Boulvard Saint-Germain. 2950 francs.

Grignard's Treatise on Organic Chemistry is not as well known in New Zealand as it should be. In a sense it is the only work of its kind as it is large work devoted to general chemical properties and preparation of the various types of organic compounds, as contrasted with Beilstein which is entirely devoted to the properties of individual compounds. In this lies its chief value. Besides giving methods of preparation and chemical reactions of the various classes of compounds, it also discusses the theoretical basis of the structures and reactions given where there is any doubt about them. This part has been very well done in the volume here which covers azo and diazo compounds, triazenes, tetrazenes, pentazdienes, azoxy derivatives, hydrazines, hydroxylamines, oximes, amidoximes and azides both in the aliphatic and aromatic divisions. A number of representative compounds are also discussed and a few details given for a considerable number of others. There is a partial author index, and over 4000 references, which are collected together at the end of the various sections, and easily located by a footnote on every page. The general get-up of the book is very attractive and at the present rate of exchange it is not dear. A very serious weakness, however, is the very large number of minor errors in references, formulae, etc. which are found on nearly every page, e.g., "Kukbride and Niwish" and "Kukbride and Nowish" for "Kirkbride and Norrish" and in the last section only 72 references in the bibliography corresponding with 75 in the text. Nevertheless this volume may be worthwhile for workers specialising in this field.

The Electronic Theory of Organic Chemistry. By M. J. S. Dewar. Oxford University Press, 1949. 324 pp. 30/-.

In recent years a number of books have been published on the electronic theory of organic reactions but Dr Dewar's book differs from these in that in it the earlier theories have been reformulated and extended on the physical basis of the molecular orbital theory. This alone makes the book worthy of careful study.

The first four chapters which deal with the quantum theory of valency and of reactions, some properties of bonds and the general principles of the electronic theory are most lucid and should be of as much interest and value to the physical and inorganic as to the organic chemist. The first chapter also includes a valuable discussion on the relationship of the valence bond (resonance) and molecular orbital approaches to the problem of molecular structure and the non-mathematical account of the molecular orbital theory as applied to carbon in its different modes of combination is the best yet seen by the reviewer.

In the rest of the book the general theory is applied to replacement and addition reactions, to aromatic compounds, molecular rearrangements, radical formation and reactions and to colour in organic compounds. The author has been able to cover a very wide field in a book of moderate dimensions by assuming a general knowledge of the reactions on the part of the reader and so restricting the discussion to theories of their mechanism.

Whether one agrees or not with the theoretical views put forward and the interpretations put on published work, the book is a most stimulating one to read.

The author has adopted the convention of signs first suggested by Sir R. Robinson for denoting the direction of polarisation due to Inductive and Electromeric Effects. Since this system is the reverse of that used by Ingold and his school and by most authors of books on this subject, some confusion is likely to occur. It is unfortunate that agreement has not yet been reached on such matters between workers in the same field in England. The same is true of the symbolism used in connection with replacement reactions, which is different in this book from that commonly used in the original literature on the subject.

The book is written in an interesting style and is well printed on good quality paper. There are some errors in formulae and equations but most of these are obvious and would not cause misunderstandings. This book should certainly find a place in the library of at least every organic chemist who is interested in the development of the theory of his subject.

—J.P.

NEW ASSOCIATES ELECTED 20/5/49.

BLAKLEY, RAYMOND LEONARD, M.Sc.—Since graduating in 1947 Mr. Blakley has been carrying out biochemical research at Canterbury Agricultural College, and more lately at the Medical School, Dunedin, following the award of a Research Fund Fellowship.

CAMPBELL, ARTHUR DEREK, M.Sc.—After completing his degree Mr. Campbell was appointed Assistant Lecturer in Chemistry at the University of Otago.

FITZGERALD, LESLIE HAROLD, B.Sc. (Lond.), A.R.I.C.—After twenty years as chemist with J. Lyons & Co., London, Mr. Fitzgerald is now chemist to Griffin and Sons Ltd., Lower Hutt.

HARRIS, PETER GRAHAM, M.Sc.—Mr. Harris has been associated with the Dominion Laboratory, Wellington, for the past six years on the analysis of paint, building materials and latterly rocks.

JOHNS, ALAN TUTTON, M.Sc., Ph.D. (Cantab.)—After serving with the armed forces for five years, Dr. Johns took his Ph.D. at Cambridge, and is now Biochemist at the Plant Chemistry Laboratory, Palmerston North.

LEVER-NAYLOR, PETER, B.Sc.—Mr. Lever-Naylor has spent the past four years with New Zealand Milk Products Ltd., and is now chemist in charge of the Laboratory.

RICHARDSON, GEORGE MAXWELL, M.Sc. (Lond.), Ph.D. (Lond.)—Dr. Richardson has specialised in Biochemical Research, and is now Research Officer with the Department of Health, Medical School, Dunedin.

ROBB, JAMES, B.Sc.—Mr. Robb has been Works Chemist at the Glendermid Tannery, Dunedin, since November, 1945.

VERE-JONES, NOEL WATERMAN, B.Sc. (Lond.), A.M.I. Chem.E.—Mr. Vere-Jones has been Chemist to Messrs. Truman, Hanbury & Buxton, London, and Production and Technical Manager with Bengers Ltd., England. He is now a Senior Chemical Engineer with the D.S.I.R., Wellington.

ABRIDGED MINUTES OF A MEETING OF COUNCIL-IN-PERSON OF THE N.Z.I.C., HELD IN THE BOARD ROOM, AUCKLAND UNIVERSITY COLLEGE, ON TUESDAY, AUGUST 23rd, 1949, AT 2.30 p.m.

Present: Professor J. Packer (President), in the chair; S. G. Brooker, Auckland delegate; J. L. Mandeno, Wellington delegate; F. H. G. Johnstone, Canterbury delegate; O. H. Keys, Otago delegate; and W. G. Hughson, Hon. General Secretary.

Also present by invitation were Dr. J. K. Dixon, immediate past president; Dr. F. B. Shorland, Chairman, Wellington Branch; B. E. Jackson, proxy for Auckland.

Conference, 1949.—Mr. Brooker reported on the 1949 Conference, which had just commenced. He pointed out that of the Australian Delegation Dr. I. W. Wark was a former Vice-President of the Royal Australian Chemical Institute, and Dr. A. L. G. Rees was Editor of the Institute's Journal. The President suggested that for future Conferences we ask the Australian Institute to nominate representatives.

Conference, 1950.—Canterbury stated that they were prepared to undertake the organisation of Conference 1950.

Resolved, Auckland/Otago: That Council confirm the nomination of Professor Packer and Mr. L. Wilkinson to the conference 1950 Committee, that the Canterbury Branch be asked to nominate three more members, that the R.I.C. (N.Z. Section) be asked to nominate two members, and that the Conference Committee be given power to co-opt further members as required.—Carried.

Eighth Pacific Science Congress.—Resolved, Otago/Wellington: That Professor Soper be asked to prepare a statement in support of our previous resolution "that future Congresses include a Division of Physical Sciences or a Division of Chemistry," showing how his suggestion for a symposium on "Chemical Industry in the Pacific Basin" could be incorporated in such a Division.—Carried.

Employment Committee.—Branches reported very little support for the employment of students in industrial laboratories during vacations. Mr. G. M. Smith to be asked to draft a reply to the Education Department setting out rates of remuneration for Technical Assistants and Technicians.

Examinations Committee.—The minutes of the Twelfth Meeting of the Examinations Committee held on August 8th, 1949, were submitted to Council. Resolved, President/Canterbury: That in addition to Elementary Bacteriology (which was approved at the May meeting of Council) three further optional subjects be approved for the Laboratory Assistants' Examination, viz: Librarianship and Typing; Foreign Language Translation; Electronics; and that the new Otago Committee be asked to prepare prescriptions for all four subjects.—Carried.

Resolved, President/Wellington: That Council accepts the recommendation of the Examinations Committee that candidates should not be permitted to nominate special optional subjects but that additions may be made to the syllabus as decided from time to time.—Carried.

New Committee: Mr. Keys announced the new Otago Committee as follows: Messrs. C. C. Roberts (chairman), G. B. Beath, A. D. Campbell, R. W. Green, H. G. Woolman and O. H. Keys. (Members of old and new committees met during Conference.)

Journal: Resolved Auckland/Canterbury: That we publish the List of Members biennially (next issue early in 1950), that we advise the Secretary, R.I.C. (N.Z. Section) accordingly, and that the Journal Committee be asked to supervise the production of a separate publication and not as part of the Journal.—

Carried.

Salmon's quote for 500 copies (24 pages plus cover) was £30/5/- (exempt from Sales Tax). Mr. Keys suggested getting quotes from elsewhere.

Bound volumes of the Journal were exhibited—1936-1948, 2 volumes. Cost of binding, £3/5/-.

Reprints.—Resolved Wellington/Otago: That our policy with regard to reprints be amended to allow 25 reprints to the author, and none for Council. Extra reprints to be ordered as required and paid for by recipient.—Carried.

Industrial Chemical Essay Prize.—Mr. Brooker raised the matter of altering the Regulations governing this award (see Regulation 3) in accordance with suggestions put forward in August, 1947.—It was decided to consider amendments after June 30th, 1950, the closing date of the next award.

Publication of Names of Applicants.—The policy of publishing names of applicants for membership in the Journal as raised by the Otago Branch was not favoured by the other three Branches.

Accounts for Payment.—Accounts totalling £166/18/9 were passed for payment.

Food Parcels.—Dr. Dixon reported on recent communications with Dr. Ellingham as set out on the Agenda for the General Meeting. All Branches are continuing to support the scheme and Dr. Dixon asked that a parcel be forwarded to each of the 24 names on the list in order to arrive for Christmas.

Amendments to Rules.—Rule 8. 2: Resolved Otago/Canterbury: That the following words be added to Rule 8.2: "or for a total period of at least seven years in a laboratory approved by the Council."—Carried.

Regulations governing I.C.I. Prize: It was generally agreed that the I.C.I. prize should be awarded to a member only once and Canterbury was asked to draft a clause to this effect.

Rule 9: A letter from Dr. Gardner stated that he had been considering the whole question of Membership Rules, and if Council was agreeable he would attempt a re-draft for submission in the first place to the Membership Committee. Resolved, President/Canterbury: That Dr. Gardner be thanked for his offer and be asked to proceed as suggested.—Carried.

Superannuation Schemes and Contracts of Service.—A few replies only had been received but Otago felt both schemes were well worth while even if the application is limited. Dr. Dixon to report to the General Meeting.

Newsletter.—Council approved Mr. J. A. D. Nash as Editor for 1949 for the Newsletter for "Chemistry and Industry," but asked that Branch Editors supply brief notes on recent local developments.

Patents Committee.—Dr. Shorland was present to enlarge on the report. Resolved, President/Canterbury: That the Patents Committee be given authority to approach the Secretary of the Public Service Commission in order to stress the need for a fully qualified chemist on the staff of the Patent Office.—Carried.

Membership.—Resolved, Auckland/Wellington: That Mr. M. L. McGlashan of Canterbury University College be granted leave of absence with remission of subscription while he continues his studies abroad.—Carried.

Resolved, President/Canterbury: That the resignation of Professor McIlroy, now of Ibadan University, Nigeria, be accepted with regret.

Reciprocity.—N.Z.I.C. and R.I.C.: This matter was held over. It is hoped to have a report from Mr. F. J. T. Grigg for the November meeting.

Professional Chemical Institute Liaison Service (PCILS): A number of papers from Dr. Ellingham, Secretary of the R.I.C. London, have been sent to the President and the Otago Branch. Papers handed to Mr. Brooker, Journal Editor.

Bookplate.—Professor Packer presented a number of suggested forms of Bookplate submitted by the Caxton Press, Christchurch.

Resolved, Wellington/Canterbury: That Council adopt the Bookplate with the Institute Seal at the top and with the name of the Institute below; printed on grey paper, and that the President be asked to order 200 copies as per sample.—Carried.

Assistant-Secretary.—Resolved Canterbury/Auckland: That Mr. Arthur P. Oliver of the Dominion Laboratory, Wellington, be appointed Assistant to the General Secretary of the Institute.—Carried.

U.N.E.S.C.O.—Report A. 168/26 received and referred to Branches particularly the section on "Food and People"—Branches to consider this in their 1950 progarmme—extra copies of booklet available at 4d.

International Conference on Biochemistry.—Dr. I. J. Cunningham has replied stating that he will represent the Institute at the Conference in August, 1949.

Compounded Subscription.—To be raised at the General Meeting.

U.N.E.S.C.O. Travel Funds.—The President stated that in certain circumstances money was made available by U.N.E.S.C.O. to enable officers of International Societies to attend Conferences—Secretary asked to seek further information.

MINUTES OF A GENERAL MEETING OF THE NEW ZEALAND INSTITUTE OF CHEMISTRY HELD IN THE CHEMISTRY LECTURE ROOM, AUCKLAND UNIVERSITY COLLEGE, ON WEDNESDAY, AUGUST 24th, 1949, at 2.30 p.m.

Present:

The President, Professor J. Packer, in the Chair, and about 65 members.

Greetings:

The Hon. Gend. Secretary was asked to send the greetings of the meeting and best wishes for recovery of health to Mr. W. Donovan and Dr. H. O. Askew.

Other Institutes:

The Hon. Gen. Secretary was asked to reciprocate the cordial greetings received from Dr. Ellingham, Secretary of the Royal Institute of Chemistry, London.

The President intimated that he would ask Dr. I. W. Wark, Head of the Australian delegation to the Conference, to convey to the Royal Australian Chemical Institute (of which he is a past Vice-President) the congratulations of the New Zealand Institute of Chemistry on the conferment of the title "Royal."

Dr. Wark will also be asked to take back with him to the Royal Australian Chemical Institute the good wishes and greetings of the New Zealand Institute of Chemistry.

Presidential Remarks:

In opening his remarks Professor Packer referred to the death of Sir Thomas Easterfield, who was the second President of the Institute. Members stood in honour of his memory.

The President then sketched the present position of the Institute with its membership of 377, noted the large number of new members joining regularly, and the elevation of three of our Associates to the Fellowship, Mr. W. L. Barr, Mr. J. J. S. Cornes and Mr. H. H. Edwards.

After several other items of interest such as the Bookplate and the Annual Newsletter for "Chemistry and Industry," the President led up to his most important announcement:—

1st I.C.I. Prize Award to Professor Briggs: The President outlined the terms of the Award and read a cablegram from Professor Heilbron. Council had made the first award of the prize to Professor Briggs of the Chemistry Department, Auckland University College. This information was received with acclamation and a resolution of congratulations was similarly carried with applause.

Reports of Sub-Committees of Council:

Reports covering the twelve-month period between Conferences were submitted by sixteen committees or representatives of Council.

(These have been set out in full on the Agenda Sheets A.169 to A.173, extra copies of which are available from the Hon. General Secretary.)

Points arising from the reports were as follows:—

Conference: Mr. G. L. Calnan, Conference Secretary, said there had been 204 registrations but five had with drawn, so the double century was barely attained.

Resolved—Mr. L. Wilkinson/Dr. C. R. Barnicoat: That a very hearty vote of thanks be accorded the members of the 1949 Conference Committee, and that they be congratulated on an excellently organised and well-run Conference.—Carried wiih acclamation.

Dr. Annett wished especially to record the thanks of the visiting ladies who very much appreciated the welcoming gift of flowers.

The President announced that Conference 1950 would be held in Christchurch.

Contracts of Service: Mr. O. H. Keys and Dr. M. M. Burns thought that the contract would be very valuable to some chemists and Dr .Dixon and his committee were congratulated on their production.

Employment Committee: Mr. G. M. Smith thought the Public Service Commission might be asked to advise our committee of vacancies being advertised for chemists.

Professor Packer stated that in each centre the committee now had three representatives from the University, Industry and Government respectively.

Examinations Committee: This committee has been developed in Wellington and this year 26 applicants are sitting 53 subjects. Other members of the Institute are setting papers and supervising the examinations for Laboratory Assistants.

A Dunedin Committee under the Chairmanship of Mr. C. C. Roberts will take over the work after the November 1949 Examinations.

Finance:

Mr. Griffin asked how a payment for the Combined Conference 1949 should appear in the N.Z.I.C. Statement of Receipts and Payments. It was explained that an advance had been made to the Conference Committee and charges had come to hand for Conference Publications.

Journal:

The Editor, Mr. S. G. Brooker, stated that since the publication of his report Council had approved the biennial publication of the List of Members—next issue early in 1950. A set of the newly-bound volumes of the Journal and reprints of Dr. Shorland's recent review on Researches on Fats and Related Constituents were on display.

Membership Committee:

Resolved—Professor Packer/Mr. G. A. Lawrence: That a letter of appreciation be sent to the three members of the Membership Committee thanking them for the work done in considering the qualifications of applicants for the Associateship and the Fellowship.—Carried.

(The members of the Committee are Mr. W. A. Joiner (Wellington), Dr. R. Gardner (Dunedin), and Dr. L. H. Briggs (Auckland).)

Mr. Griffin raised certain points relating to Rule 8 and the requirement that applicants obtain a University Certificate when applying for membership.

Rule 5 and Regulation 8 were then cited. On the suggestion of Mr. Lambert it was decided to ask Mr. Griffin to forward his points to Council for consideration.

Patents Committee:

Dr. Shorland and Dr. Nauen discussed the difficulties of providing copies of chemical patents to interested members.

Dr. Shorland said copies would be available in each centre and attention could be drawn to the relevant patents.

Professional Status Committee:

Mr. J. Ricketts, convener, said this committee was recently set up in the Auckland Branch but was already considering matters of interest to members.

Salaries:

Dr. Dixon said there had been no major activity by this committee during the year.

Standards Institute Council:

In addition to his report as submitted in the agenda, Mr. G. A. Lawrence explained some of the activities of the Standards Council and said there was a proposal to form a Physical Committee on which he thought a number of problems would concern chemists. The matter was referred to Council for consideration.

Standards Institute Committees:

Mr. M. L. H. Stewart supplemented his long report with a suggestion that more active work should be proceeding in the matter of timber preservation.

Resolved—Mr. M. L. H. Stewart/Dr. J. C. Andrews: That the N.Z.I.C. feels that with the increased use of pinus radiata and sap timbers a more positive attitude is required towards timber preservation and in consequence requests its representative on the Standards Council (Mr. G. A. Lawrence) to place the N.Z.I.C. views before the Standards Institute Council.—Carried.

Superannuation Schemes:

Dr. Dixon asked if there was any demand for such a scheme.

Most members seem already satisfied but it was agreed that Branches should communicate the names of any interested members to Council.

U.N.E.S.C.O.:

Professor Packer said that Council had recommended that Branches consider discussion groups on "Food and People" during 1950.

Dr. A. T. Johns asked if UNESCO would sponsor translations from Russian.

The Hon. Gen. Secretary was asked to see Mr. D. Cairns of the National Commission for UNESCO in N.Z. with regard to this question.

Mr. Griffin asked that Council approach the National Commissioner for UNESCO with the suggestion that Dr. H. N. Parton be sent round New Zealand to discuss UNESCO affairs at specially arranged meetings.

Resolved—Mr. O. H. Keys/Dr. H. E. Annett: That all reports from sub-committees be received and adopted and that Secretaries and members of committees be thanked for the immense amount of work done on behalf of the Institute.—Carried with applause.

Food Parcels:

The thanks of the R.I.C. were acknowledged in a letter from Dr. Ellingham, Secretary of the R.I.C.

The Industrial Chemical Essay Prize:

The President stated that this prize was now of the value of £25 and the next competition closed on June 30th, 1950.

Vice-Presidential Election, 1948:

Mr. K. M. Griffin moved the following motion as set out on the Agenda for the meeting (A.174):—"That this general meeting of the N.Z.I.C. condemns the action of the Wellington Branch Committee in making a nomination for the Vice-Presidency after the Auckland Branch had, with the approval of the Wellington Delegate, and without objection from the Wellington Branch, in accordance with the accepted practice faithfully honoured by Auckland in the past, been asked to make a nomination, and had in annual general meeting made and notified a nomination."

Mr. A. L. Odell seconded the motion "pro forma."

In speaking to the motion Mr. Griffin then read out a statement which is on record and which was forwarded previously to Council and to the Wellington Branch.

The Chairman then made a brief general statement following which Mr. O. H. Keys moved and Mr. S. R. Sieman seconded the following amendment:—That this meeting regrets the prolongation of differences of opinion as to the mode of nomination of the Vice-President in 1948 and calls upon members to leave the matter as constitutionally determined by Council after consultation with the Branches.

The amendment was put to the meeting and was carried unanimously on the voices.

After a brief discussion on the amendment as the substantive motion, Professor Worley moved and Dr. Annett seconded: That the motion be not put and that the meeting proceed to the next business on the Agenda.

This motion was carried, Mr. Keys only dissenting.

Reciprocity between N.Z.I.C. and R.I.C.:

The President stated that Journals and publications were now being exchanged with the R.I.C. and with other Empire Institutes under the "Professional Chemical Institutes Liaison Service" (P.C.I.L.S.).

Life or Compounded Subscription:

Several members spoke in favour of such a scheme provided the necessary safeguards were instituted.

Resolved—Dr. J. C. Andrews/Mr. H. H. Edwards: That this annual meeting recommends to Council that it re-examines the question of compounded subscriptions with a view to making provision for members over fifty years of age to be eligible for payment of such subscriptions with such safeguards as are necessary to protect the interests of the Institute.—Carried.

Assistant-Secretary:

The President announced that Council had appointed Mr. A. P. Oliver, Assistant to the Hon. General Secretary.

Duties of Registrar:

The Hon. General Secretary outlined the work regularly undertaken by the Registrar stating that over a period of 12 months 700 letters were received or despatched. Much of this work was re-directed to sub-committees but the Registrar had to keep continuous touch with items such as applications for enrolment as members, etc. The other main activity of the Registrar was the keeping of the financial record for the Institute and the production of the annual balance.

Mr. Griffin expressed the hope that the newly-appointed Assistant Secretary would be asked to attend to all applications.

Resolved—Dr. F. Nauen/Mr. F. H. G. Johnstone: That this meeting express its appreciation of the work and interest of the Registrar over the past year.

Speech Training:

Professor Worley commented on the poor oratorical efforts of a number of the Conference lecturers and of members participating in the discussions.

Dr. Annett and Mr. Griffin supported Professor Worley's suggestion for a course in speech therapy and the meeting loudly applauded this general attitude.

Nominations for Office:

Dr. M. M. Burns suggested to Council that any Branch putting forward a nomination for an elective position should forward with the nomination a supporting statement setting out the record of the nominee in Institute affairs. This would be forwarded to Branches through the Hon. General Secretary.

Personal and General

Mr. S. R. Siemon, Lecturer in Applied Chemistry, Canterbury College, has been appointed Branch Editor in succession to Mr M. L. McGlashan, who is going overseas.

Mr J. Brown, Biochemist at Auckland Hospital, and sub-editor of this Journal, left last month to do post-graduate work at the Royal Infirmary, Edinburgh.

We were glad to have the opportunity of meeting Dr. A. L. G. Rees, Editor of the Journal of the Royal Australian Chemical Institute, at the Auckland Conference.

Mr. J. Vaughan, M.Sc. (Wales) arrived recently from Great Britain to take up a lectureship in Organic Chemistry at Canterbury University College. He graduated in 1941, when he went as a research chemist to the Armament Research Department of the Ministry of Supply. In 1946 he became research chemist to Crookes Laboratories Ltd.; from 1947 to 1949 he was lecturer in chemistry at University College, Swansea.

Our next issue will contain a full transcript of Prof. Packer's Presidential Address to the Conference in Auckland. His subject was "Electronic Theory of Organic Chemistry," in which field he is particularly well versed.

Advance orders are now being received for the Proceedings of the Seventh Pacific Science Congress, which will be published in six or seven volumes. It is hoped to complete printing by March 1950. Further information may be obtained from the Secretary-General, Box 27, Newmarket, Auckland, S.E.1.

The Industrial Chemical Essay Prize to be awarded next year will be of an increased value of £25, conditions being otherwise as set out in the Rules and Regulations, pages 17-18. The closing date for the receipt of entries is 30th June next.

An active Wellington Committee, convened by Dr. J. K. Dixon, has drawn up a form of contract for service, and has also reported on superannuation schemes. Copies of both are available from Branch Secretaries.

Dr. E. W. R. Steacie, F.R.S., Director of the Division of Chemistry, National Research Council, Ottawa, has been elected President of the Chemical Institute of Canada. In 1944-46 he was Deputy-Director of the British Canadian Atomic Energy Project.